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PATENT

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Sir:

This is a request for filing a patent application under 37 C.F.R. 1.53(b) of
Applicant(s): Spendler et al.

Title: Preparation Of Dough And Baked Products

13 pages of specification 3 sheets of Declaration and Power of Attorney

[x] The filing fee is calculated as follows:

| | |
|---|----------|
| Basic Fee: | \$760.00 |
| Total Claims: $18 - 20 = 0 \times 18 =$ | \$0 |
| Independent Claims: $4 - 3 = 1 \times 78 =$ | \$ 78.00 |
| Total Fee: | \$838.00 |

Priority of Danish application serial no. 0543\98 filed on April 20, 1998 is
claimed under 35 U.S.C. 119. A certified copy thereof is submitted herewith.

Priority of U.S. provisional application serial no. 60/083,277 filed on April 28,
1998 is claimed under 35 U.S.C. 119.

Address all future communications to Steve T. Zelson, Esq., Novo Nordisk of
North America, Inc., 405 Lexington Avenue, Suite 6400, New York, NY 10174-6401.

Please charge the required fee, estimated to be \$838, to Novo Nordisk of North
America, Inc., Deposit Account No. 14-1447. A duplicate of this sheet is enclosed.

Respectfully submitted,

Date: April 5, 1999

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PREPARATION OF DOUGH AND BAKED PRODUCTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority under 35 U.S.C. 119 of U.S. provisional application no. 60/083,277 filed April 28, 1998 and Danish application no. 0543/98 filed April 20, 1998, the contents of which are fully incorporated herein by reference.

FIELD OF THE INVENTION

The invention relates to process for preparing a dough or a baked product prepared from the dough. More particularly, it relates to such a process where the bread has an improved softness, both when eaten on the same day and when eaten after several days of storage.

BACKGROUND OF THE INVENTION

It is well known that the softness of bread deteriorates during storage from the time of baking to the time of consumption. The term staling is used to describe such undesirable changes in the properties of the bread. Staling results in an increase of the firmness of the crumb, a decrease of the elasticity of the crumb, and changes in the crust, which becomes tough and leathery.

Enzymatic retardation of staling by means of various amylases has been described. Thus, US 2,615,810, US 3,026,205 and O. Silberstein, "Heat-Stable Bacterial Alpha-Amylase in Baking", Baker's Digest 38(4), Aug. 1964, pp. 66-70 and 72, describe the use of alpha-amylase. WO 91/04669 (Novo Nordisk) describes the use of a maltogenic alpha-amylase from *Bacillus stearothermophilus*. It is also known to use β -amylase to retard staling.

It is also known to add a phospholipase to dough. Thus, US 4,567,046 and EP 171,995 (both to Kyowa Hakko) disclose that the addition of phospholipase A enhances the properties of dough and bread, including retardation of the staling.

M.R. Kweon et al., Journal of Food Science, 59 (5), 1072-1076 (1994) disclose the effect of 2-4 % by weight of phospholipid hydrolysate together with an anti-staling amylase on the retrogradation of starch in bread.

SUMMARY OF THE INVENTION

The inventors confirmed that the addition of an anti-staling amylase reduces the rate of crumb firming during storage for 1-7 days after baking, but they found that there is a need to improve the softness in the initial period after baking, particularly the first 24 hours after baking. They further found that this can be achieved by using a

phospholipase, so that bread made by the combined use of an anti-staling amylase and a phospholipase has improved softness, both when eaten on the same day and when stored for several days after baking. There is no significant change in the taste or smell of the baked product.

5 Accordingly, the invention provides a process for preparing a dough or a baked product prepared from the dough which comprises adding to the dough an anti-staling amylase and a phospholipase. The invention also provides a dough and a pre-mix comprising these ingredients.

10 DETAILED DESCRIPTION OF THE INVENTION

Anti-staling amylase

The anti-staling amylase used in the invention may be any amylase that is effective in retarding the staling (crumb firming) of baked products.

The amylase preferably has a temperature optimum in the presence of starch
15 in the range of 30-90°C, preferably 50-80°C, particularly 55-75°C, e.g. 60-70°C. The
temperature optimum may be measured in a 1 % solution of soluble starch at pH 5.5.

The anti-staling amylase may be an endo-amylase, preferably a bacterial endo-amylase, e.g. from *Bacillus*. A preferred example is a maltogenic alpha-amylase (EC 3.2.1.133), e.g. from *Bacillus*. A maltogenic alpha-amylase from *B. stearothermophilus* strain NCIB 11837 is commercially available from Novo Nordisk A/S under the tradename Novamyl®. It is further described in US 4,598,048 and US 4,604,355 and in C. Christophersen et al., Starch, vol. 50, No. 1, 39-45 (1997).

Other examples of anti-staling endo-amylases are bacterial alpha-amylases, derived e.g. from *Bacillus*, particularly *B. licheniformis* or *B. amyloliquefaciens*.

25 The anti-staling amylase may be an exo-amylase such as β -amylase, e.g. from plant (e.g. soy bean) or from microbial sources (e.g. *Bacillus*).

The anti-staling amylase is added in an effective amount for retarding the staling (crumb firming) of the baked product. The amount of anti-staling amylase will typically be in the range of 0.01-10 mg of enzyme protein per kg of flour, e.g. 1-10 mg/kg. A maltogenic alpha-amylase is preferably added in an amount of 50-5000 MANU/kg of flour, e.g. 100-1000 MANU/kg. One MANU (Maltogenic Amylase Novo Unit) may be defined as the amount of enzyme required to release one μmol of maltose per minute at a concentration of 10 mg of maltotriose (Sigma M 8378) substrate per ml of 0.1 M citrate buffer, pH 5.0 at 37 °C for 30 minutes.

Phospholipase

The phospholipase may have A₁ or A₂ activity to remove fatty acid from the phospholipid and form a lyso-phospholipid. It may or may not have lipase activity, i.e. activity on triglycerides. The phospholipase preferably has a temperature optimum in the range of 30-90°C, e.g. 30-70°C.

The phospholipase may be of animal origin, e.g. from pancreas (e.g. bovine or porcine pancreas), snake venom or bee venom. Alternatively, the phospholipase may be of microbial origin, e.g. from filamentous fungi, yeast or bacteria, such as the genus or species *Aspergillus*, *A. niger*, *Dictyostelium*, *D. discoideum*, *Mucor*, *M. javanicus*, *M. mucedo*, *M. subtilissimus*, *Neurospora*, *N. crassa*, *Rhizomucor*, *R. pusillus*, *Rhizopus*, *R. arrhizus*, *R. japonicus*, *R. stolonifer*, *Sclerotinia*, *S. libertiana*, *Trichophyton*, *T. rubrum*, *Whetzelinia*, *W. sclerotiorum*, *Bacillus*, *B. megaterium*, *B. subtilis*, *Citrobacter*, *C. freundii*, *Enterobacter*, *E. aerogenes*, *E. cloacae* *Edwardsiella*, *E. tarda*, *Erwinia*, *E. herbicola*, *Escherichia*, *E. coli*, *Klebsiella*, *K. pneumoniae*, *Proteus*, *P. vulgaris*, *Providencia*, *P. stuartii*, *Salmonella*, *S. typhimurium*, *Serratia*, *S. liquefaciens*, *S. marcescens*, *Shigella*, *S. flexneri*, *Streptomyces*, *S. violeceoruber*, *Yersinia*, or *Y. enterocolitica*. A preferred phospholipase is derived from a strain of *Fusarium*, particularly *F. oxysporum*, e.g. from strain DSM 2672, as described in co-

The phospholipase is added in an amount which improves the softness of the bread during the initial period after baking, particularly the first 24 hours. The amount of phospholipase will typically be in the range of 0.01-10 mg of enzyme protein per kg of flour (e.g. 0.1-5 mg/kg) or 200-5000 LEU/kg of flour (e.g. 500-2000 LEU/kg).

A phospholipase with lipase activity is preferably added in an amount corresponding to a lipase activity of 20-1000 LU/kg of flour, particularly 50-500 LU/kg. One LU (Lipase Unit) is defined as the amount of enzyme required to release 1 µmol butyric acid per minute at 30.0°C; pH 7.0; with Gum Arabic as emulsifier and tributyrin as substrate.

Phospholipase activity (LEU)

In the LEU assay, the phospholipase activity is determined from the ability to hydrolyze lecithin at pH 8.0, 40°C. The hydrolysis reaction can be followed by titration with NaOH for a reaction time of 2 minutes. The phospholipase from porcine pancreas has an activity of 510 LEU/mg (taken as standard), and the phospholipase from *Fusarium oxysporum* has an activity of 1540 LEU/mg.

Phospholipid

The phospholipase may act on phospholipid provided by flour in the dough, so the separate addition of a phospholipid is not required. However, the softening ef-

fect may be increased by adding a phospholipid, preferably in an amount of 0.05-20 g/kg of flour, e.g. 0.1-10 g/kg. The phospholipid may be a diacyl-glycero-phospholipid, such as lecithin or cephalin.

Dough

5 The dough of the invention generally comprises wheat meal or wheat flour and/or other types of meal, flour or starch such as corn flour, corn starch, rye meal, rye flour, oat flour, oat meal, soy flour, sorghum meal, sorghum flour, potato meal, potato flour or potato starch.

The dough of the invention may be fresh, frozen or par-baked.

10 The dough of the invention is normally a leavened dough or a dough to be subjected to leavening. The dough may be leavened in various ways, such as by adding chemical leavening agents, e.g., sodium bicarbonate or by adding a leaven (fermenting dough), but it is preferred to leaven the dough by adding a suitable yeast culture, such as a culture of *Saccharomyces cerevisiae* (baker's yeast), e.g. a com-
15 mercially available strain of *S. cerevisiae*.

The dough may also comprise other conventional dough ingredients, e.g.: proteins, such as milk powder, gluten, and soy; eggs (either whole eggs, egg yolks or egg whites); an oxidant such as ascorbic acid, potassium bromate, potassium iodate, azodicarbonamide (ADA) or ammonium persulfate; an amino acid such as L-cysteine;
20 a sugar; a salt such as sodium chloride, calcium acetate, sodium sulfate or calcium sulfate.

The dough may comprise fat (triglyceride) such as granulated fat or shortening, but the invention is particularly applicable to a dough where less than 1 % by weight of fat (triglyceride) is added, and particularly to a dough which is made without
25 addition of fat.

The dough may further comprise an emulsifier such as mono- or diglycerides, diacetyl tartaric acid esters of mono- or diglycerides, sugar esters of fatty acids, polyglycerol esters of fatty acids, lactic acid esters of monoglycerides, acetic acid esters of monoglycerides, polyoxyethylene stearates, or lysolecithin, but the invention is par-
30 ticularly applicable to a dough which is made without addition of emulsifiers (other than optionally phospholipid).

Additional enzyme

Optionally, an additional enzyme may be used together with the anti-staling amylase and the phospholipase. The additional enzyme may be a second amylase,
35 such as an amyloglucosidase, a beta-amylase, a cyclodextrin glucanotransferase, or the additional enzyme may be a peptidase, in particular an exopeptidase, a transglu-

taminase, a lipase, a cellulase, a hemicellulase, in particular a pentosanase such as xylanase, a protease, a protein disulfide isomerase, e.g., a protein disulfide isomerase as disclosed in WO 95/00636, a glycosyltransferase, a branching enzyme (1,4- α -glucan branching enzyme), a 4- α -glucanotransferase (dextrin glycosyltransferase) or
 5 an oxidoreductase, e.g., a peroxidase, a laccase, a glucose oxidase, a pyranose oxidase, a lipoxygenase, an L-amino acid oxidase or a carbohydrate oxidase.

The additional enzyme may be of any origin, including mammalian and plant, and preferably of microbial (bacterial, yeast or fungal) origin and may be obtained by techniques conventionally used in the art.

10 The xylanase is preferably of microbial origin, e.g. derived from a bacterium or fungus, such as a strain of *Aspergillus*, in particular of *A. aculeatus*, *A. niger* (cf. WO 91/19782), *A. awamori* (WO 91/18977), or *A. tubigensis* (WO 92/01793), from a strain of *Trichoderma*, e.g. *T. reesei*, or from a strain of *Humicola*, e.g. *H. insolens* (WO 92/17573, the contents of which is hereby incorporated by reference). Pentopan® and
 15 Novozym 384® (both from Novo Nordisk A/S) are commercially available xylanase preparations produced by *Trichoderma reesei*.

The amyloglucosidase may be an *A. niger* amyloglucosidase (such as AMG™, available from Novo Nordisk A/S, Denmark). Other useful amylase products include Grindamyl® A 1000 or A 5000 (available from Grindsted Products, Denmark) and
 20 Amylase® H or Amylase® P (available from Gist-Brocades, The Netherlands).

The glucose oxidase may be a fungal glucose oxidase, in particular an *Aspergillus niger* glucose oxidase (such as Gluzyme®, available from Novo Nordisk A/S, Denmark).

The protease may in particular be Neutrase® (available from Novo Nordisk
 25 A/S, Denmark).

The lipase may be derived from a strain of *Thermomyces* (*Humicola*), *Rhizomucor*, *Candida*, *Aspergillus*, *Rhizopus*, or *Pseudomonas*, in particular from *Thermomyces lanuginosus* (*Humicola lanuginosa*), *Rhizomucor miehei*, *Candida antarctica*, *Aspergillus niger*, *Rhizopus delemar* or *Rhizopus arrhizus* or *Pseudomonas*
 30 *cepacia*. In specific embodiments, the lipase may be Lipase A or Lipase B derived from *Candida antarctica* as described in WO 88/02775, or the lipase may be derived from *Rhizomucor miehei* as described in EP 238,023, or *Humicola lanuginosa* described in EP 305,216, or *Pseudomonas cepacia* as described in EP 214,761 and WO 89/01032.

35 **Baked product**

The process of the invention may be used for any kind of baked product prepared from dough, either of a soft or a crisp character, either of a white, light or dark

type. Examples are bread (in particular white, whole-meal or rye bread), typically in the form of loaves or rolls, French baguette-type bread, pita bread, tortillas, cakes, pancakes, biscuits, cookies, pie crusts, crisp bread, steamed bread, pizza and the like.

5 Pre-mix

The present invention further relates to a pre-mix comprising flour together with an anti-staling amylase, a phospholipase and a phospholipid. The pre-mix may contain other dough-improving and/or bread-improving additives, e.g. any of the additives, including enzymes, mentioned above.

10 Enzyme preparation

The invention provides an enzyme preparation comprising an anti-staling amylase and a phospholipase, for use as a baking additive in the process of the invention. The enzyme preparation is preferably in the form of a granulate or agglomerated powder. It preferably has a narrow particle size distribution with more than 95 %

15 (by weight) of the particles in the range from 25 to 500 μm .

Granulates and agglomerated powders may be prepared by conventional methods, e.g. by spraying the amylase onto a carrier in a fluid-bed granulator. The carrier may consist of particulate cores having a suitable particle size. The carrier may be soluble or insoluble, e.g. a salt (such as NaCl or sodium sulfate), a sugar (such as

20 sucrose or lactose), a sugar alcohol (such as sorbitol), starch, rice, corn grits, or soy.

EXAMPLES

Example 1

Bread was baked with anti-staling amylase, phospholipase and phospholipid.

25 As reference, bread was also baked without one or more of these ingredients.

The phospholipid was lecithin at a dosage of 10 g/kg. The phospholipase was from *Fusarium oxysporum* used at a dosage of 50, 250 or 500 LU/kg, corresponding to 0.04, 0.19 or 0.38 mg/kg. The anti-staling amylase was a maltogenic alpha-amylase from *B. stearothermophilus* (Novamyl) at a dosage of 750 MANU/kg (1 mg/kg). All

30 dosages in the Examples were based on kg of flour.

Doughs were prepared according to a standard European straight dough procedure with 50 g yeast per kg of flour and 40 ppm of ascorbic acid. The doughs were scaled to 350 g and baked in lidded pans.

The crumb firmness was measured using a texture analyzer TA-XT2 from
35 Stable Micro Systems. Texture was measured according to a modified ACCA method

(American Cereal Chemists' Association). These measurements were made after 0 days (approximately 2 hours after baking) and again after 1, 2 and 7 days storage (wrapped in double plastic bags and stored at 22°C).

The results are shown as firmness versus additive and storage time:

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| Additives | Phospho- lipase dos- age (LU/kg) | 2 hours | 1 day | 2 days | 7 days |
|---|--|---------|-------|--------|--------|
| Invention: Anti-staling amylase + phos- pholipase + phos- pholipid | 50 | 316 | 417 | 517 | 868 |
| | 250 | 279 | 371 | 455 | 790 |
| | 500 | 248 | 324 | 410 | 752 |
| Reference: | | | | | |
| None (control) | 0 | 296 | 875 | 1207 | 2162 |
| Anti-staling amy- lase | 0 | 469 | 563 | 801 | 1083 |
| Phospholipid + phospholipase | 50 | 208 | 470 | 782 | 1560 |
| | 250 | 231 | 467 | 721 | 1424 |
| | 500 | 233 | 420 | 649 | 1303 |

Example 2

- 5 A baking test was made as in Example 1, but with dosages of 0.5 mg/kg of the phospholipase (770 LEU/kg) and 1 g/kg of the phospholipid. The results are given as firmness after storage, and for comparison the firmness is also expressed in % of the control.

| Additives | 2 hours | 5 hours | 12 hours | 20 hours | day 2 | day 3 |
|--|---------------|---------------|---------------|---------------|---------------|---------------|
| Invention: Anti-staling amy- lase + phospholi- pase + phospholipid | 181 (78%) | 195 (65%) | 223 (51%) | 241 (46%) | 277 (34%) | 303 (32%) |
| Reference: | | | | | | |
| None (control) | 233 (100%) | 302 (100%) | 434 (100%) | 526 (100%) | 824 (100%) | 959 (100%) |
| Anti-staling amylase | 372 (160%) | 468 (155%) | 518 (119%) | 482 (92%) | 547 (66%) | 637 (66%) |
| Phospholipid + phospholipase | 144 (62%) | 144 (47%) | 212 (49%) | 258 (49%) | 364 (44%) | 482 (50%) |

Example 3

A baking test was made as in Examples 1 and 2, using a different phospholipase. The phospholipase was from porcine pancreas at a dosage of 2 mg/kg (1020 LEU/mg). The dosages of the anti-staling amylase and the phospholipid were as in Example 2, and the results are presented as in Example 2:

| Additives | 2 hours | 5 hours | 12 hours | 20 hours | day 2 | day 3 |
|--|---------------|---------------|---------------|---------------|---------------|----------------|
| Invention: Anti-staling amylase + phospholipase + phospholipid | 342 (122%) | 411 (103%) | 420 (80%) | 431 (73%) | 485 (52%) | 559 (48%) |
| Reference: None (control) | 281 (100%) | 398 (100%) | 524 (100%) | 588 (100%) | 937 (100%) | 1157 (100%) |
| Anti-staling amylase | 409 (146%) | 490 (123%) | 514 (98%) | 526 (89%) | 625 (67%) | 673 (58%) |
| Phospholipid + phospholipase | 218 (76%) | 260 (65%) | 367 (70%) | 472 (80%) | 668 (71%) | 906 (78%) |

The results of Examples 1-3 show that the addition of anti-staling amylase retards the crumb firming during storage, but increases the initial firmness compared to the control without additives. The addition of phospholipid + phospholipase according to the invention is effective in avoiding the increased initial firmness and further reduces the rate of crumb firming during storage, compared to the anti-staling amylase alone.

Example 4

Bread loaves were baked with and without phospholipid (lecithin) as indicated below. The phospholipase was *F. oxysporum* used at a dosage of 1 mg/kg (1540 LEU/kg). The anti-staling amylase and the baking conditions were as described in Example 1. The results are given as firmness after storage:

| | | | | Firmness | | |
|-----------|------------------------------------|------------------------|----------------------|----------|-------|--------|
| | Anti-staling amylase MANU/kg | Phospholipase mg/kg | Phospholipid g/kg | 2 hours | 1 day | 3 days |
| Control | 0 | 0 | 0 | 294 | 687 | 1179 |
| Invention | 750 | 1 | 10 | 200 | 229 | 277 |
| | 750 | 1 | 2 | 167 | 218 | 287 |
| | 750 | 1 | 1 | 167 | 232 | 305 |
| | 750 | 1 | 0.5 | 189 | 269 | 333 |
| | 750 | 1 | 0.1 | 196 | 260 | 381 |
| | 750 | 1 | 0 | 199 | 264 | 372 |

The results show that addition of anti-staling amylase and phospholipase
 5 clearly improves the softness, both initial softness (2 hours) and softness after storage
 (3 days). The softening effect can be further improved by addition of phospholipid.
 The optimum dosage appears to be about 1 mg/kg of phospholipid.

What is claimed is:

1. A process for preparing a dough or a baked product prepared from the dough, comprising adding to the dough an anti-staling amylase and a phospholipase.
2. The process of claim 1 wherein the anti-staling amylase has optimum activity
5 in bread at 70-90°C.
3. The process of claim 1 wherein the anti-staling amylase is an endo-amylase from *Bacillus*,.
4. The process of claim 1 wherein the anti-staling amylase is a maltogenic al-
pha-amylase.
- 10 5. The process of claim 1 wherein the phospholipase has a temperature optimum of 30-70°C.
6. The process of claim 1 wherein the phospholipase is of fungal origin.
7. The process of claim 1 which further comprises incorporating a phospholipid into the dough.
- 15 8. The process of claim 1 which does not comprise addition of fat.
9. The process of claim 1 which does not comprise addition of lysophospholipid.
10. The process of claim 1 which does not comprise addition of emulsifiers other than the phospholipid.
11. The process of claim 1 wherein the dough consists essentially of flour, water,
20 yeast, salt and sugar.
12. A dough which comprises an anti-staling amylase and a phospholipase.

13. A pre-mix for dough comprising flour, an anti-staling amylase and a phospholipase.

14. An enzyme preparation which comprises an anti-staling amylase and a phospholipase.

5 15. The preparation of claim 14 which further comprises a phospholipid.

16. The preparation of claim 15 which further comprises a hemicellulase.

17. The preparation of claim 14 which is a granulate or an agglomerated powder.

18. The preparation of claim 14 wherein more than 95 % (by weight) has a particle size between 25 and 500 μm .

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ABSTRACT OF THE DISCLOSURE

Disclosed is a process for preparing a dough or a baked product from the dough which process involves incorporating into the dough an anti-staling amylase and a phospholipase. The bread made by the combined use of an anti-staling amy-
5 lase and a phospholipase has improved softness, both when eaten on the same day and when stored for several days after baking. There is no significant change in the taste or smell of the baked product.

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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Preparation Of Dough And Baked Products

the specification of which (check only one item below):

☐ is attached hereto

☒ was filed as United States application

Application No. to be assigned

on April 5, 1999

and was amended

on _____

☐ was filed as PCT international application

Number _____

on _____

and was amended under PCT Article 19

on _____

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code, §119 of any provisional or foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR U.S. PROVISIONAL/FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

| COUNTRY (if PCT, indicate "PCT") | APPLICATION NUMBER | DATE OF FILING (day, month, year) | PRIORITY CLAIMED UNDER 35 USC 119 |
|-------------------------------------|--------------------|--------------------------------------|---|
| Denmark | 0543/98 | 20 April 1998 | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
| United States | 60/083,277 | 28 April 1998 | <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO |
| | | | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| | | | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| | | | <input type="checkbox"/> YES <input type="checkbox"/> NO |
| | | | <input type="checkbox"/> YES <input type="checkbox"/> NO |

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

Attorney's Docket Number
5539.200-US

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this applications is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT
UNDER 35 U.S.C. 120:

U.S. APPLICATIONS

STATUS (Check one)

U.S. APPLICATION NUMBER

U.S. FILING DATE

Patented

Pending

Abandoned

PCT APPLICATIONS DESIGNATING THE U.S.

APPLICATION NO.

FILING DATE

US SERIAL NUMBERS
ASSIGNED (if any)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

Steve T. Zelson Reg. No. 30,335 Elias J. Lambiris Reg. No. 33,728 Valeta A. Gregg Reg. No. 35,127 Carol E. Rozek Reg. No. 36,993 Robert L. Starnes Reg. No. 41,324 Reza Green Reg. No. 38,475

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| | | | | |
|---|-------------------------|---|---|---|
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| 4 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

Attorney's Docket Number
5539.200-US

| | | | | |
|---|-------------------------|---------------------|--------------------------|--------------------------|
| 5 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |
| 6 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |
| 7 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |
| 8 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |
| 9 | Full Name of Inventor | Family Name | First Given Name | Second Given Name |
| | Residence & Citizenship | City | State or Foreign Country | Country of Citizenship |
| | Post Office Address | Post Office Address | City | State & Zip Code/Country |

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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|-------------------------|-------------------------|-------------------------|
| Signature of Inventor 1 | Signature of Inventor 2 | Signature of Inventor 3 |
| Date | Date | Date |
| Signature of Inventor 4 | Signature of Inventor 5 | Signature of Inventor 6 |
| Date | Date | Date |
| Signature of Inventor 7 | Signature of Inventor 8 | Signature of Inventor 9 |
| Date | Date | Date |